IRON MANUFACTURE OF OHIO.

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There are few territories of equal extent with the State of Ohio, that are so abundantly provided with the means of industrial wealth. The great fertility and yield of her agricultural regions have long been known, and the cultivation of her rich valleys has given prosperity and riches to a large population. Concerning, however, the character and utilization of the immense stores of coal and iron, locked up in the rocks of the Coal Measures, which underlie so large a portion of the State, the general information has been limited in extent and accuracy. Nevertheless, private explorations and private enterprise have developed an industry in the manufacture of iron, which places Ohio second only to Pennsylvania among the iron producing States of the Union. A full knowledge of the occurrence and character, and an intelligent employment of these raw materials, the coals and iron ores, so pre-eminently the foundation of the necessities and comforts of our age, becomes a matter of the very greatest importance to a people possessing them. And the work of the present Geological Survey, in collecting and generalizing the facts observed relating to those mineral staples, and their use in our own and other States and countries, must afford a firm basis for the certain and rapid progress of the manufactures dependent upon them. Information, which too often has been the exclusive property of the invester, will be thus accessible to both the owner of the land and the capitalist who develops the riches beneath it, and this information, so

long wanted will redound to the common interest and the prosperity of the State. A knowledge also of the principles involved in the manufactures, raising the coals and iron ores, and the method and apparatus employed elsewhere in our own and other countries, it is hoped, will favor a more general appreciation of the applications of science, skill and accuracy to these manufactures.

All the iron ores of any value in Ohio are found among the rocks of the Coal Measures, and although they are quite abundant in this formation, it is only in a few regions that they are in sufficient quantities to sustain important iron industries, so that the chief supply of ores is now, and will be, obtained from other States. The rich and pure specular ores of Lake Superior, the magnetites of Canada, etc., readily transportable by the waters of the great lakes to her northern shores, meet first in the coals of Ohio the supply of fuel, in which those regions are so deficient. Hence it is that the coals of Ohio are the most important element in her mineral industry, and the one upon which the existence and progress of Ohio as an iron manufacturing State must, of necessity, be mainly dependent. The character and extent of the Coal Measures has already been most thoroughly discussed in portions of the geological reports, and the continuation and value of each seam of coal and deposit of iron ore traced in all their variations of importance through the entire area. The geological map already published by the Survey, and the local maps of the present volume, exhibit the extent of this area in Ohio. The various points of the manufacture being denoted, their relations to each other, to the different parts of the coal area, and to the various means of transportation, will be readily appreciated.

The iron manufacture of the State is divided into several districts, and a description of the peculiar conditions is given in another place of each region separately, with quite full details, referring to their situation and relations, the fuel area as used, the furnaces and their economy, the general facts of the methods of working, and the character and uses of the iron produced. It is intended, however, to make a summary of the general condition of iron manufacture in the State, under the following heads, namely: means of transportation; general character of the Coal Measures in Ohio; the fuels used, their characters, etc.; the different ores

employed; general facts and results of the blast furnace practice; and, finally, statistical facts regarding the manufacture in the State. The districts and places where the manufacture of iron is principally carried on, are situated in the eastern part of the State, as all the mineral fuel employed is derived from the coal measures which underlie the eastern third of the State. Facilities of transportation, the existence of other industries or large communities, however, are creating important iron manufacturing establishments at considerable distances from the supply of fuel, as at various points along the lake shore, etc. The principal points, nevertheless, of the iron industry of the State will be within the limit of the coal area, or closely connected to it by railroad communication. While the districts and chief centers of the manufacture will be spoken of more fully at another place, brief mention may be made here of those towns which stand foremost in the iron industry of the State. First—Cleveland, on the shore of Lake Erie, is the great seaport or distributing place of the ores of Lake Superior, Canada, etc., for Northern Ohio and Western Pennsylvania, as well as being the commercial center for the iron manufacture of Northern Ohio. It also possesses itself large iron works, which are destined to be multiplied greatly, and make the Cleveland district of Ohio a great manufacturing center, a rival to its namesake, the celebrated Cleveland district of England, besides being the principal source for supplying the markets accessible by the chain of the great lakes. Second—Closely connected by railroad and every interest, Youngstown, in Mahoning County, is the chief town and manufacturing center of the celebrated region of the Mahoning Valley, and for real enterprise and quantity of product this region leads the manufacture in the State. Third—Steubenville, on the Ohio River, is the seat of an important iron industry, which is more closely connected in conditions of manufacture and interests with Pittsburgh than with Cleveland. Fourth—The Ohio towns, Martin's Ferry, Bridgeport and Bellaire, opposite to Wheeling. These towns and Wheeling, though now occupying a minor position in the iron manufacture on the Ohio River, by the unusual facilities which they have for water and railroad communication, and the enormous supplies of fuel in the great coal seam, which is everywhere visible in the vicinity, must soon occupy a pre-eminent

one in this manufacture in the valley of the Ohio. Fifth—Ironton, in the extreme southern part of the State, on the Ohio, in Lawrence county, is now the center of the celebrated Hanging Rock region, and an important point of manufacture. The circumstances of the supply of ores and and fuels, transportation, etc., more fully alluded to when describing the region, offer such conditions that we may anticipate for it progress and high position among the manufacturing towns of the State. Beside these chief points mentioned, there are others whose importance is not so great, as Leetonia, in Columbiana County, Massillon or the Tuscarawas Valley, Zanesville, Jackson. Columbus, and the Hocking Valley. On the lake shore, besides Cleveland, there are several places yet almost unknown as manufacturing points, where the facilities of communication with the supply of fuel from the coal area and the ores from the lakes seem to present very favorable conditions for successful industries, as Painesville, Ashtabula, Black River, Sandusky and Toledo. At the latter place, however, there are already successful enterprises in operation.

In the modern manfacture of iron there is hardly any problem of greater importance than that of transportatian, in the distribution of the ores and fuel, and marketing the products. Whether it is more economical, in any given case, to carry the ores to the fuel or the fuel to the ores, or to establish the manufacture at an intermediate point, are questions depending upon so many considerations, as to the relative expense of transporting the ore and fuel, cost of labor, the position of large manufacturing centers or markets, that they demand the most careful investigation before the erection of expensive establishments.

Before the conception of the vast railroad enterprises of the present time, the extensive canal system of Ohio was a just subject of pride to its inhabitants. But the railroad, in its rapid extension over the State, either by rivalry or by purchase, has reduced these expensive canals, with but very small exceptions, to the state of dry ditches, and as means of communication they have become things of the past. Though without any navigable stream within its own limits, Ohio, with the waters of the great lakes washing its northern shores, and the broad and navigable Ohio bordering its southern limits, has an extent of water communica-

tion which gives it almost the advantages of a sea-coast. By Lake Erie, the great lakes and the St. Lawrence, its vessels may pass from Duluth, at the extreme west of Lake Superior, to Quebec and the Atlantic Ocean on the east, a distance of 1,500 miles. while by the Ohio River it has a ready communication to all the points from Pittsburgh to St. Louis, and the Mississippi River to New Orleans, a distance of 2,090 miles. All the ores of Lake Superior are shipped either at Marquette, on Lake Superior, or from Escanaba, on Green Bay, Lake Huron, in barges, sailing vessels, or steamers, many of which are built especially for the traffic, and as return cargoes they take back coal. Owing to the length of the winter in this northern region, the traffic lasts but a portion of the year, from about May 1 to November 1. At Cleveland almost all the sale of these ores is conducted, and while portions of the ores are delivered at various other places on the shore of Lake Erie, Detroit, Erie, Buffalo, etc., by far the largest proportions are received and transhipped at Cleveland, from whence they are distributed by railroad to Pittsburgh and other places in Western Pennsylvania, and at the many points in Ohio, etc. Beside the Lake Superior ores, considerable quantities of the Canadian ores from Lake Ontario north of Kingston, of the Lake Champlain ores of Northern New York, and small proportions of other ores from the States, etc., bordering on the lakes, are received at Cleveland, and likewise distributed to the various points of manufacture with which she is in communication.

The following table shows the total receipts of iron ore in Cleveland from Lake Superior for ten years ending, 1871 to 1881, in tons:

1871	395,721
1372	622,059
1873	674,324
1874	456,692
1875	245,801
1876	141,268
1877	505,974
1878	509,332
1879	525,402
1880	718,983
1881	826,419

These figures are from the report of the Cleveland Board of Trade for 1882.

Cleveland is also a shipping place for very large quantities of coal, which is distributed to various points on the lakes from Buffalo to Chicago, Marquette and Duluth. The cost of lake transportation is low, but somewhat variable. During June, 1882, the freight for water transportation of iron ore was, from Marquette to the Lake Erie ports, $1.25 per ton, and from Escanaba, $1.00.

The Ohio River, which borders the southeastern and southern part of the State, is the great natural highway for the products of the Ohio Valley, and is navigable for its entire length from Pittsburgh to the waters of the Mississippi. The demand which is made by the Ohio Valley for a cheap and certain mode of transportation is impressing every year more and more strongly the necessity for some permanent improvement in the navigation of the Ohio River, and whatsoever that system may be, it must eventually be carried out, to the no small advantage of the country bordering its passage. The railroads will be employed where cost can be sacrificed to the rapidity of transportation, but for the products of the soil, the mines and the iron works, the waters of the river are the true conveyor. And, the dense population which the valley of the Ohio is destined to sustain, will require the greatest obtainable facilities of the Ohio, as well as all the present and more railroads. The chief importance of the river in its relation to the present iron industry of Ohio, is the means which it affords for the importation of the Missouri iron ores, the carriage of coal, etc., from one point to another, and the shipment of its crude and finished products to the various markets from Pittsburgh, Cincinnati, Louisville, etc., to the waters of the Mississippi. Thus the various iron works at Ironton, Wheeling, Steubenville, etc., on the river banks, have a ready means of communication with the Missouri ores, the coals and markets which always give to places so situated on an extensive system of water intercourse many advantages above those located inland. Though as a carrier, the river is of course slow in comparison with the railroads, still this inequality is rendered less when the lower cost and the much larger bulks which may be moved at once are considered.

The railroad systems of Ohio are the connecting links of the great trunk lines between the country of the west and northwest, and the Atlantic seaboard, and in their numerous crossings and interlocking, they cover the State like a net-work, and connect together the remotest corners.

The magnificent forests which covered the country west of the Alleghenies, at the time of the early settlers, provided a cheap and abundant source of fuel for smelting purposes, when the needs of the inhabitants demanded it. However, the rapid growth of the population, the clearing of the forests for agricultural and building purposes, together with the demands of the iron smelter, soon compelled the iron-masters to look elsewhere than to charcoal for fuel, so that now coal has replaced the use of wood where iron is smelted throughout the State, excepting in the extreme southern part, and in a few localities in the northwest, where it is still conducted. Notwithstanding that the manufacture of charcoal pig-iron is still a very important industry in Southern Ohio, it does not require much foresight to see that its importance is on the wane, and that ere long it must necessarily yield to the use of mineral fuel. Such has been the history of all the great iron manufacturing regions of the world when coal was accessible. Thus England, which in 1788 had 24 charcoal furnaces out of a total of 77, in 1872 had less than 5 in a total of 950. In the United States, east of the Alleghenies, the use of charcoal as a blast-furnace fuel has been or is being entirely superseded by mineral fuel, and such must be the result whenever the facilities of obtaining coal render its use possible. Considering, however, the supply of timbered land which Ohio still possesses, and the high value of charcoal pig-iron, this industry will be of some importance for considerable time to come. By a system of care and strict economy in the use of wood, and the employment of the best and most approved modes of manufacture, its duration can be lengthened, though the final fate of the industry is certain.

It may be safely stated, that at present (1884) eight-ninths of this available timber land of the Southern Ohio manufacturing districts has been cleared. Many furnaces are compelled to obtain their fuel from such a distance that its transportation becomes a very serious item in the cost of the iron made.